

## Economic Wear Protection For the Iron and Steel Industry Worldwide



### Reduce Costs and Avoid Downtime

Large quantities of bulk material are handled in the conveying and storing systems of the iron and steel industry. Unless they are suitably protected these systems will experience frequent failure requiring repair or replacement. Kalenborn offer the complete array of wear protection materials including not only ceramic and metallic materials but also plastics and rubber.

In addition, Kalenborn have extensive experience in the field of slide promotion. Interruptions of material flow inside of bunkers and silos must be avoided and Kalenborn cover the entire material range with plastics as well as metallic and ceramic materials.



In any case we can supply a tailor-made solution for your particular problem. Our experts are prepared to be of assistance.



*Bunkers for blast furnace charging are effectively lined with KALOCER*

*Kalenborn in action: short installation times thanks to the use of sprayed-on KALCRET*

## Pipes, Components and Service



*Long duty cycles for wear protected pipes*



*Extended service life of plant components*



*Kalenborn Service solves wear problems on site*

### Optimal Solution for Every Plant Component

Plant components are at risk in all sections of the iron and steel industry, especially in raw material storage and processing, sintering and coking plant, blast-furnace operation and slag handling. Comprehensive wear protection is an absolute must for steel production systems and rolling mills as well.

Service lifetimes of many years are often achieved with the following materials:

- ABRESIST fused cast basalt
- KALCOR zirconium corundum
- KALCOR-S sintered zirconium corundum
- KALOCER high alumina ceramics
- KALCRET hard compound
- KALSICA silicon carbide ceramics
- KALMETALL-C hard casting
- KALMETALL-W hard overlay welding
- KALINOX slide promotion steel
- KALEN slide promotion plastics

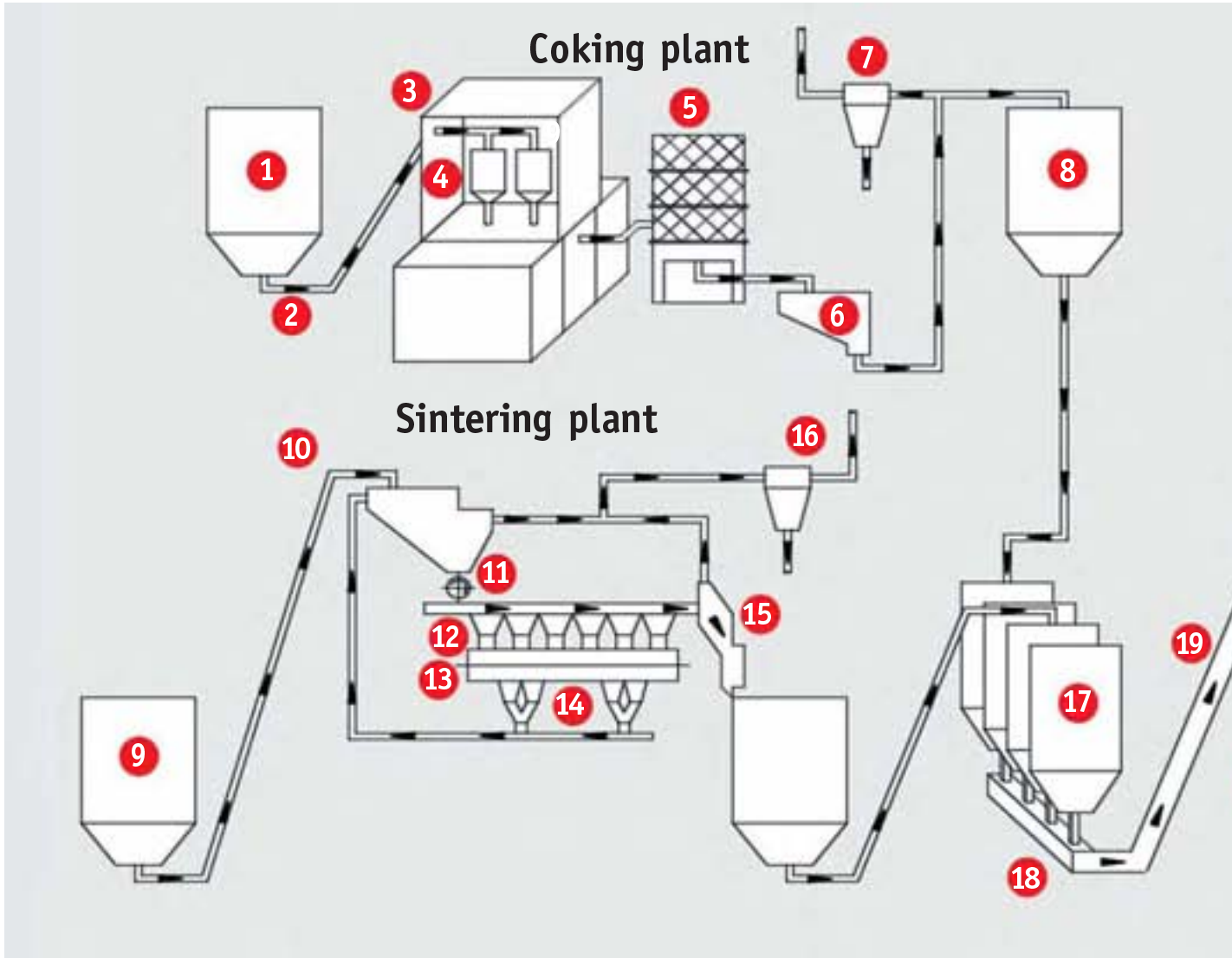
In addition, material combinations have been very successful in practice. They enable both technically and economically optimal solutions.

### Wear Protected Components

Components	Lining Materials
<b>Cyclones</b>	ABRESIST, KALCOR, KALOCER, KALSICA, KALMETALL-W
<b>Fan housings</b>	KALOCER, KALCRET, KALMETALL-C, KALMETALL-W
<b>Fan rotors</b>	KALOCER, KALMETALL-W
<b>Gates</b>	KALOCER, KALCOR, KALSICA, KALMETALL-W, KALCRET
<b>Hydraulic conveyors</b>	ABRESIST, KALCOR, KALOCER, KALCRET
<b>Mechanical conveyors</b>	ABRESIST, KALOCER, KALCRET, KALMETALL-C, KALMETALL-W
<b>Nozzles</b>	KALOCER, KALSICA
<b>Pneumatic conveyors</b>	ABRESIST, KALCOR, KALOCER, KALCRET, KALMETALL-C, KALMETALL-W
<b>Pumps</b>	KALSICA
<b>Screens</b>	KALMETALL-C, KALMETALL-W
<b>Transfer stations</b>	ABRESIST, KALOCER, KALMETALL-W
<b>Valves and Fittings</b>	KALOCER

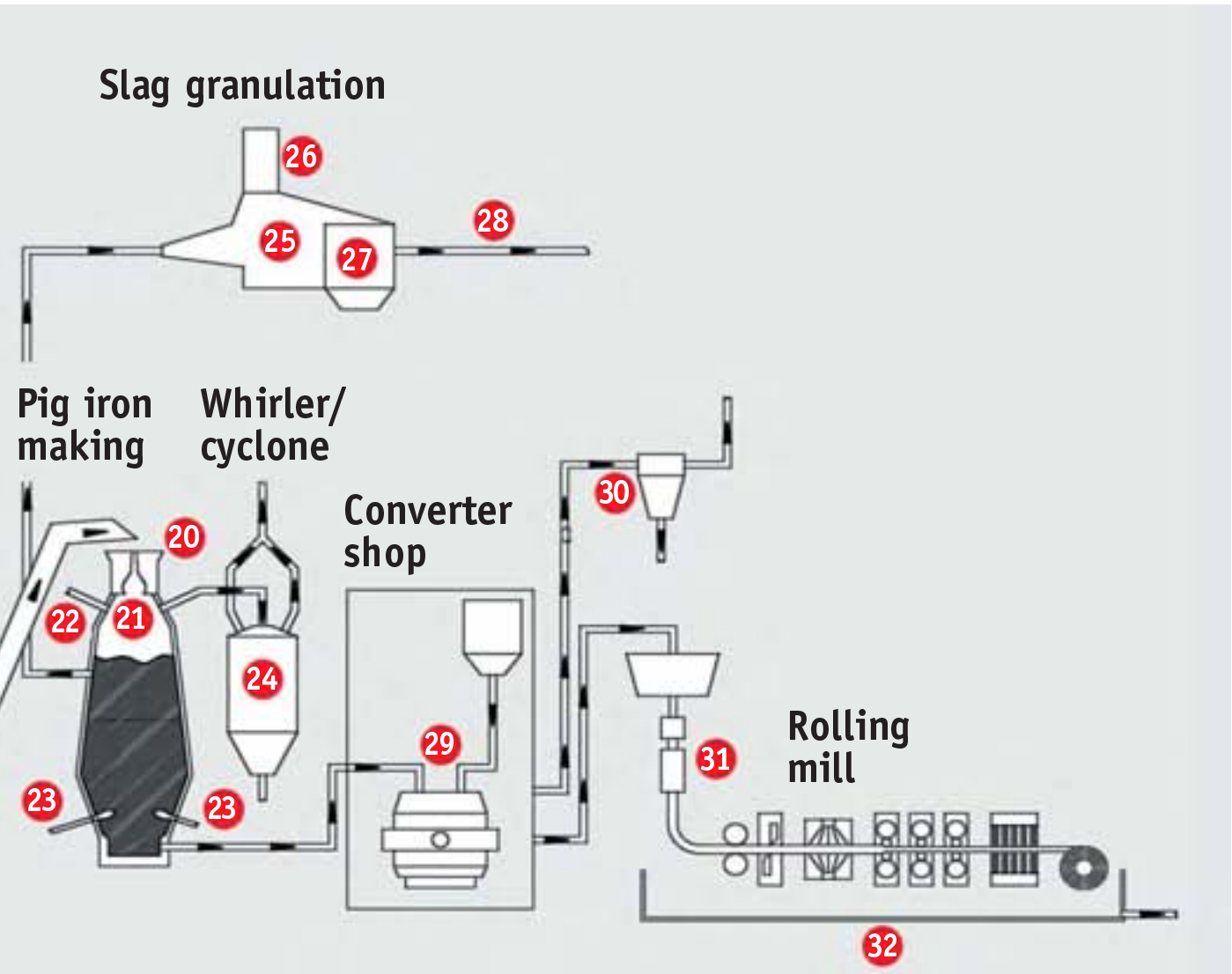
Material Handled / System	Plant Component	Lining Material as Wear Protection / Slide Promotion*
<b>COKING PLANT</b>		
<b>1</b> Coal	Raw coal bunker	ABRESIST
<b>2</b>	Crushers, mills	KALMETALL-C, KALMETALL-W
<b>3</b>	Transfer chutes	KALMETALL-C, KALCOR, KALOCER
<b>4</b>	Fine coal bunkers	KALEN*, KALCERAM*
<b>5</b> Coke	Quenching tower	ABRESIST, KALCRET, KALCOR-S
<b>6</b>	Coke loading bays	KALCOR, KALSICA, KALCERAM-K*, KALMETALL-C
	Coke screens	KALMETALL-W, KALMETALL-C
<b>7</b>	Dust collection - cyclones - pipes	ABRESIST, KALCRET ABRESIST, KALCRET, KALMETALL-W
	Transfer chutes	KALCOR, KALMETALL-C, KALMETALL-W
<b>8</b>	Bunkers	ABRESIST, KALOCER, KALCOR, KALMETALL-W
<b>SINTERING PLANT</b>		
<b>9</b> Raw ore	Bunkers	ABRESIST, KALMETALL-W, KERAFLEX
<b>10</b>	Transfer chutes	KALOCER, KERAFLEX, KALMETALL-W
<b>11</b> Sintered material	Feed drums	KALOCER, KALMETALL-W
<b>12</b>	Wind boxes	KALCRET
<b>13</b>	Flue-gas manifold	ABRESIST, KALCRET, KALCOR
<b>14</b>	Return hopper below wind boxes	KALMETALL-W, KALCOR
<b>15</b>	Discharge tables	KALMETALL-W, KALCOR
	Toothed crushers	KALMETALL-W, KALMETALL-C
	Screen bars	KALMETALL-W
	Hot material screens	KALMETALL-W
	Coolers	KALMETALL-W
	Cold material screens	KALMETALL-W, KALMETALL-C
<b>16</b>	Dust collection - cyclones - fans - pipes	ABRESIST, KALCOR, KALMETALL-W KALMETALL-W ABRESIST, KALCOR, KALMETALL-W, KALCRET
<b>BLAST FURNACE</b>		
<b>17</b> Raw materials (ore, sintered, material, coke, fluxes)	Burden bunkers	ABRESIST, KALOCER, KALMETALL-W
<b>18</b>	Discharge-/vibratory conveyors	KALOCER, KALMETALL-W
<b>19</b> Feeding	Skip carriages	KALOCER
	Various chutes/distributors (e.g. skip collecting chute, octagonal hopper)	KALOCER
<b>20</b>	Throat stopper	KALOCER, KALMETALL-C, KALMETALL-W

# Reliable Control of Wear Problems



21	<b>Blast furnace</b>	Distributor chute Throat armor	KALMETALL-W KALMETALL-W
22		Pressure compensating pipe	ABRESIST, KALMETALL-W, KALCRET, KALOCER
23		Pulverized coal injection	KALOCER, ABRESIST
24	<b>Dedusting</b>	Whirler	KALCRET, KALCOR
<b>SLAG GRANULATION</b>			
25	<b>Slag</b>	Granulating system	KALMETALL-C, KALCRET, ABRESIST, KALOCER
26		Condensation tower	KALCRET, KALMETALL-W, KALMETALL-C, KALOCER
27		Brake boxes Distributor	KALOCER, KALMETALL-W, KALCRET KALOCER, KALMETALL-W, KALCRET
28		Hydraulic transport	ABRESIST, KALCOR

# Work with Kalenborn for Your Optimal Solution



CONVERTER SHOP		
29	Pig Iron	Charging - chutes - pipes
30		Dust collection - cyclones
ROLLING MILL		
31	Plate mill	Descaling sprays
32		Scale launders
IRON OXIDE GRINDING		
	Iron oxide	Grinding mills Transport Fans
ELECTRO FURNACE		
	Coal and limestone	Injection pipes

## Reliable Operation in Coking Plants

*Coke loading bay: the impact edge is protected by KALMETALL-C 153 hard casting, the sliding surface with KALCERAM-K hard ceramics and the stressed sides with KALSICA-P silicon carbide ceramics*

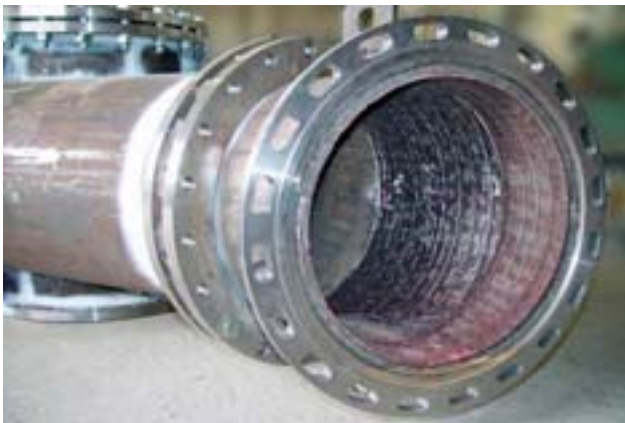


*A trouble-free material flow is ensured in coal bunkers by the use of KALEN slide promotion plastics*

*Discharge edge of a coke loading bay; the KALMETALL-C hard cast components are fixed mechanically without visible elements*



*Kalenborn also successfully use KALCOR zirconium corundum and KALCRET hard compound in the area of coke loading bays*



*Pipe for coke conveying made of KALMETALL-W 100 hard overlay welding, inner diameter 500 mm*



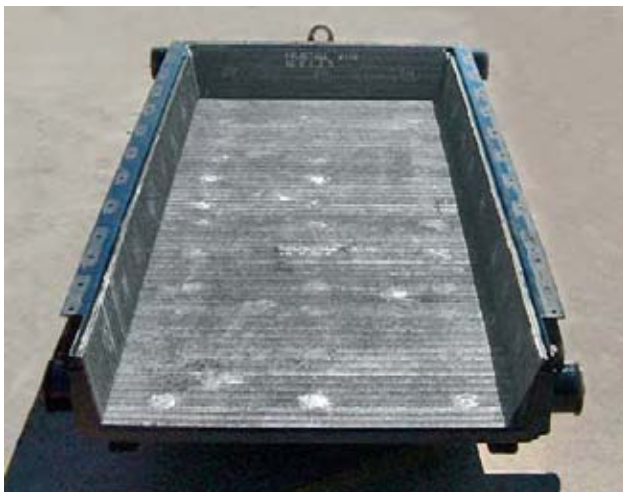
*Proven wear protection material for bunkers in the coke handling is ABRESIST fused cast basalt*

# Long Duty Cycles in Sintering Plants

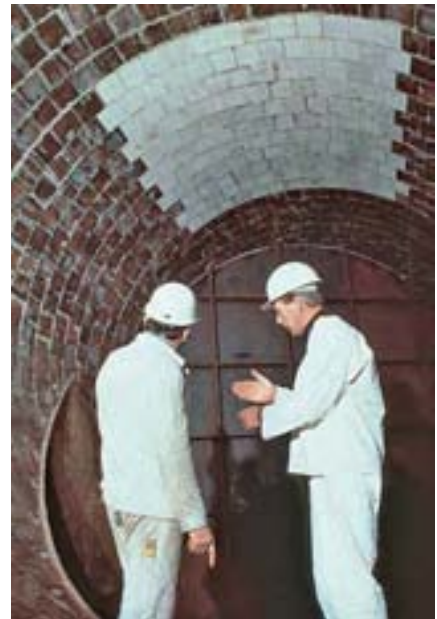
*Collecting hopper being part of sintered material dust collection at 400° C/752 °F: effectively protected with KALCOR zirconium corundum*



*Lining of a vibratory chute made of KALMETALL-W 143 hard overlay welding; the lined surface covers 10 m<sup>2</sup>*



*Quick installation of abrasion resistant lining for wind boxes, i.e. sprayed-on KALCRET-BNS hard compound*



*Screens for hot sintered material made of KALMETALL-W 145; the screen surface is of herring-bone pattern*



*KALCOR zirconium corundum fitted to the deflection zone where abrasive sintered particles impinge at temperatures of 250°C/482 °F and high velocity, an economic solution when combined with ABRESIST fused cast basalt*

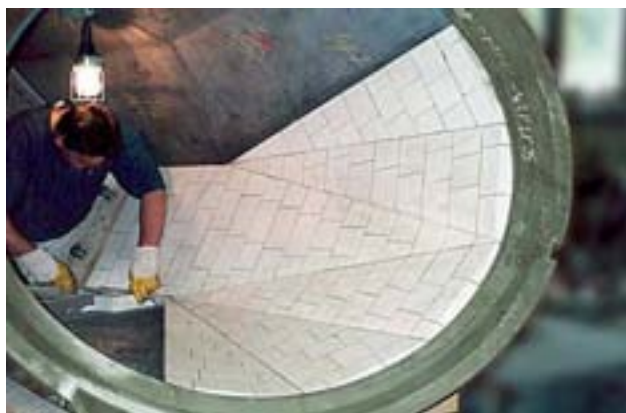
## Trouble-free Operation of the Blast Furnace



*Pressure compensating pipe at the blast furnace; self-supporting structure of KALMETALL-W 100 30 + 6 hard overlay welding; 450 mm Ø*



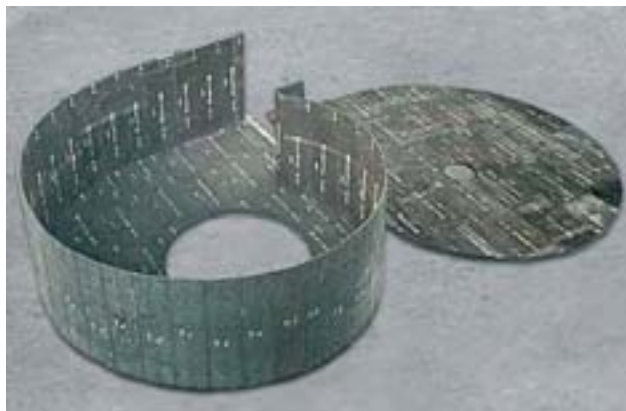
*Distributor tilting chute being part of blast furnace lining fitted with KALOCER oxide ceramics, 50 mm thick*



*Octagonal hopper with KALOCER lining; for optimal adaptation the 50 mm thick shaped elements have been cut three-dimensionally*



*Feeding hopper integrated in the blast furnace with mechanically fixed KALOCER tiles*



*Wear protected fan housing of KALMETALL-W hard overlay welding, 2,000 mm Ø*



# From Feeding to Dust Collection



*Cyclone separator cones of KALMETALL-W 100 6 + 4 fixed by means of bolt welding*



*Short lining times for a whirler thanks to sprayed-on KALCRET-BTS hard compound; the high application rate is 5 m<sup>2</sup>/h*



*KALCOR zirconium corundum is a suitable lining material even at high temperatures and high thermal cycling*

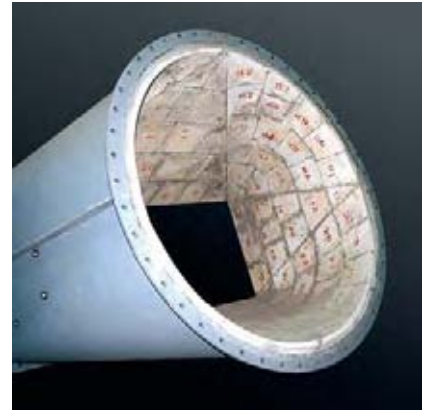


*Depending on the specific plant design dust collection cyclones are protected either with ABRESIST fused cast basalt, KALCOR zirconium corundum, KALCRET hard compound or KALMETALL-W hard overlay welding*



*Dust collection cyclones for blast furnaces are effectively protected with KALCOR zirconium corundum*

**Slag Handling and Other Applications**



*KALCRET hard compound has stood the test as lining material in components of slag granulating systems. Depending on their specific geometry the plant components can be lined within a minimum of time by trowelling or by the spraying technique.*

*KALCOR zirconium corundum is the ideal wear protection material in case of high stress caused by wear, temperatures and temperature changes; not only lining of plant components but also of pipes is feasible*

*Time-proven in troughs of slag granulation: KALCRET hard compound*



*Brake box of a slag granulating system; in the zone of maximum wear the structure of KALMETALL-W has been lined with KALOCER tiles*



*Conveyor screw being part of a slag granulating system; screw flights lined with KALMETALL-C 155; the screw has a diameter of 1,200 mm*

# Long Duty Cycles of Plant Components



*KALFLEX pipe bends in practical operation; here shown as flexible connection between rigid connection points*



*Chain conveyors are effectively protected with ABRESIST, KALOCER, KALMETALL-W or KALCRET*



*Down pipes of a direct reduction line made of KALMETALL-W 151, 355 mm diameter; basic material 1.4829 of 12.8 mm*



*KERAFLEX is a composite material that combines the hardness of KALOCER oxide ceramics with impact resistant rubber*



*Scale launders are effectively lined with ABRESIST fused cast basalt*



*Prefabricated KALCRET guide vane for a dust collection cyclone*

### Wear Resistant Linings

Lining	Material Hardness		Process Parameters					Impact wear resistance	Remarks
	Mohs(1)	Vickers HV (2)	Max. conveying velocity m/sec	Material density g/cm <sup>2</sup>	Max. temperature (3)		Thermal shock resistance		
					°C	°F			
KALSICA-S silicon carbide ceramics	9.3	(2,300)	35	>3.0	1,000	1,832	++++	++	For extreme applications
KALOCER high alumina ceramics	9.1	(2,100)	>30	>3.0	350	662	0	+	Standard tiles, thin wall cylinders and tiles
KALCOR zirconium corundum	9	(2,000)	>30	>3.0	800	1,472	++	++	Large tiles, shaped elements, great wall thickness
KALSICA-N silicon carbide ceramics	8.8	(1,800)	>25	>3.0	1,000	1,832	+++	+	Good temperature resistance/thermal shock resistance
KALCOR-S sintered zirconium corundum	8.5	(1,600)	>25		800	1,472	+++	++	Economic KALCOR
KALCRET-B hard compound	8.1	(1,250)	22	≤3.0	800	1,472	+++	+	Supplied in bags, no joints, high temperatures
ABRESIST fused cast basalt	8	(1,140)	22	≤3.0	350	662	0	+	Flow volumes up to 3.0 g/cm <sup>3</sup> , up to 22 m/sec, limited temperatures
KALMETALL-W 100 hard overlay welding	(7.5)	700	20	-	350	662	++	++	Impact resistant, low weight
KALMETALL-C hard casting	(7.2)	580	20	-	350	662	++	+++	Impact resistant, economic in case of large quantities
KALCERAM hard ceramics	6	(500)	-	-	350	662	0	+	Bunker lining, slide promotion

(1) The Mohs scale is applicable only to ceramic materials - no more than comparison values for other materials (values given in brackets)

(2) The Vickers HV values are only valid for metallic materials - no more than comparison values for other materials (values given in brackets)

(3) The specified temperatures refer to standard applications; other temperatures must be agreed upon with the technical departments of Kalenborn

### Slide Promotion Linings

Lining	Slide Promotion	Max. Temp.		Wear Resistance	Remarks
		°C	°F		
KALEN slide promotion plastics	+++++	80	176	+	No corrosion, very smooth surface, low weight
KALINOX slide promotion steel	+++	550	1,022	++	Slide promotion in case both sliding wear and sticking problems exist
KALCERAM hard ceramics	+++	350	662	+++	Slide promotion and more efficient wear protection
ABRESIST fused cast basalt	+++	350	662	++++	Good material flow in case of hard, abrasive conveyed material

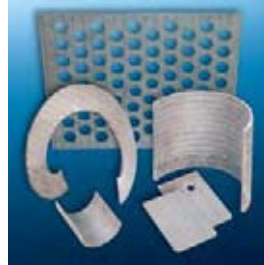
# Proven Kalenborn Offerings



## ABRESIST fused cast basalt

Mineral protection made of cast basalt to protect against abrasive wear.

Advantages: high wear resistance, permanent smooth surface, no corrosion.



## KALMETALL-W hard overlay welding

Tough basic body and hard overlay welding with primary chromium carbides.

Advantages: highly wear resistant, good resistance against impact wear, self-supporting structures.



## KALCOR zirconium corundum

Cast or sintered material made of alumina and zirconia oxide.

Advantages: high wear resistance, resistant against high temperatures, corrosion resistant.



## KALMETALL-C hard casting

Different materials characterized by corresponding resistance against abrasion and impact wear.

Advantages: alloy matched to the specific application, of advantage in case of larger quantities.



## KALOCER high alumina ceramics

Special oxide ceramics for plant components subject to extreme wear.

Advantages: high wear resistance, permanent smooth surface, no corrosion.



## KALCRET hard compound

Cement bonded compound for jointless protection to be trowelled, cast or sprayed-on.

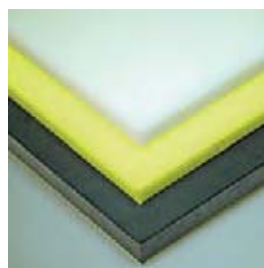
Advantages: high wear resistance and compressive strength, jointless, temperature resistant.



## KALSICA silicon carbide ceramics

Suitable for plant components that are exposed to extreme wear and/or high temperatures.

Advantages: highly wear resistant, resistant against thermal shocks and producible with narrow dimensional tolerances.



## KALEN slide promotion plastics

Range of different polyethylene (PE) and polyurethane (PU) materials.

Advantages: good durability, free of corrosion, smooth surface.

### Advantages of Lining Materials

#### Ceramic wear protection

- very good abrasion resistance
- tile, cylindrical or jointless lining
- temperatures up to 1,000 °C / 1,832 °F

#### Metallic wear protection

- good resistance against sliding and impact wear
- thin walls, self-supporting structures
- good thermal shock resistance

#### Plastic lining

- excellent slide promotion
- good resistance against impact wear
- low weight

#### Material combinations

- optimal wear protection for every application
- optimized lining cost
- optimized weight

## Optimal Solution for all Requirements



*Octagonal hopper with three-dimensionally cut shaped elements made of KALOCER oxide ceramics and KALMETALL-C hard casting, each 50 mm thick. This design avoids the risk of abrasion through the joints.*



*Tailor-made cast shaped elements of KALCOR zirconium corundum warrant reliable wear protection in the cone of a dust collector, even at high temperature and heavy thermal cycles.*

*Installation of a pressure compensating pipe to the blast furnace. The self-supporting structure made of KALMETALL W 100 30 + 6 has a diameter of 450 mm.*



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